PRECISION TIME AND FREQUENCY TRANSFER UTILIZING SONET OC-3 [1]

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ABSTRACT

An innovative method of distributing precise time and reference frequency to users located several kilometers from a frequency standard and master clock has been developed by the Timing Solutions Corporation of Boulder, CO. The Optical Two-Way Time Transfer System (OTWTTS) utilizes a commercial SONET OC-3 facility interface to physically connect a master unit to multiple slave units at remote locations (in this particular implement at ion, five slave units are supported). Optical fiber is a viable alternative to standard copper cable and microwave transmission. Coaxial cable is lossy with relatively poor temperature stability. Microwave transmission is expensive and may introduce unwanted noise and jitter into the reference signals. Optical fibers are the preferred medium of distribution because of low loss, immunity to EMI/RFI, and temperature stability. At the OTWTTS remote end, a slave local oscillator is locked to the master reference signal bya clock recovery PLL. Data signals are exchanged in both directions in order to calibrate the propagation delay over long distances and to set the slave time *precisely* to the master on-time 1PPS. The OTWTTS is capable of maintaining, without degradation, the HP5071 cesium standard stability and spectral purity at distances up to 10 km from the frequency standards central location.

This paper discusses measurements of frequency and timing stability over the OTWTTS. Two reels of optical fiber, each exactly 10.6 km in length, were subjected to temperature variations from -20°C to +50°C with a 24 hour period. The master and slave units were independently subjected to -1 15 °C to +25°C temperature variations (hardware specification). Preliminary results indicate that the OTWTTS performs as specified and does not degrade the quality of the cesium reference signal. Worst case environmental tests of the OTWTTS indicate Allan deviation on the order of parts in 10^{14} at averaging times of 1000 and 10,000 seconds; thus, the link stability degradation due to environmental condit ions still maintains HP5071 cesium performance at the user locations.

The OTWTTS described in this paper was designed and built by Timing Solutions Corporation of Boulder, CO. Environmental testing of the hardware and associated optical fibers was performed at Jet Propulsion Laboratory, Pasadena, CA, under contract with the U.S. Navy Fleet Industrial Supply Center, Bremerton, WA.

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